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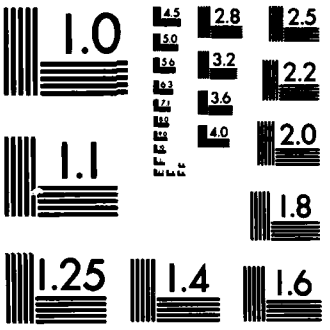

MICROCOPY RESOLUTION TEST CHART
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The Defense Mapping Agency (DMA) has a mission to provide Mapping, Charting and Geodetic (MC&G) support to Department of Defense, Services and Unified and Specified Commands. Inherent in this mission is the support to developmental systems. The DMA effort in supporting these developmental systems has gradually shifted from the standard map and chart to the soft copy or digital domain.

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C^3I's Silent Partner

by

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Abstract

The Defense Mapping Agency (DMA) has a mission to provide Mapping, Charting, and Geodetic (MC&G) support to the Secretary of Defense, the Joint Chiefs of Staff, the Military Departments and the DoD Components. Inherent in this mission is the support to developmental systems. The DMA effort in supporting these developmental systems has shifted from the standard map and chart to the soft copy or digital product.

This paper describes the DMA support to current systems such as Cruise Missile, Pershing, and flight simulators as background, leading up to what DMA envisions as the needs of the C^3I community. The paper will discuss DMA support to these systems, such as PAVE MOVER, and include the identification of some systems that are being developed without DMA support. A summary describes the concerns, from a DMA viewpoint, regarding support to the C^3I development.

Introduction

When one refers to the concept of a "silent partner" the context is usually synonymous with a financial backer of a business venture who wishes to remain anonymous. This "silent partner" concept can readily be adapted to the Defense Mapping Agency (DMA) role in the development and support to a weapon system. Some consider DMA not only a silent partner but an invisible one also. To rectify this anonymity problem one needs only to gain some insight into the mission and functions of DMA, and how DMA's presence is manifested in the daily occurences of military life and weapon deployment and use.

BACKGROUND

On 1 July 1972, the mapping charting, and geodetic (MC&G) activities within the three Military Departments were consolidated into a new agency of the U.S. Department of Defense (DoD), known as the Defense Mapping Agency (DMA) with headquarters in Washington, D.C. All map and chart production and distribution facilities of the Departments of the Army, Navy, and Air Force became Production Centers under the direction of DMA.

The separate Centers functioned technically as they did before the establishment of DMA; however, the acquisition of new data at an ever increasing rate, and changing requirements called for new methods of processing and managing data, especially in digital form. Consequently, over a period of time, manual compilation and production functions tended to become more and

more automated. With this automation came the establishment of data bases containing many standard elements; i.e. vegetation, terrain elevation, independent of their use in aeronautic, hydrographic or topographic applications. Advancement of technology within DMA towards increasing uniformity of production techniques and processes, especially between the Hydrographic and Topographic Centers, predicated a decision by DMA to merge these two Centers in September 1978. Coincident with this consolidation, the distribution functions of all three DMA Production Centers were combined into a single new command; namely, the Office of Distribution Services (DMAODS), located very near the Hydrographic/Topographic Center (HTC), in Brookmont, Maryland.

Mission and Functions

The mission of DMA is to provide mapping charting and geodetic (MC&G) support and services to the Secretary of Defense, the Joint Chiefs of Staff, the Military Departments and other DoD components through the production and worldwide distribution of maps, charts, precise positioning data, and digital data for strategic and tactical military operations and weapon systems. DMA also serves as Program Manager and coordinator of all DoD MC&G resources and activities, and carries out statutory responsibilities (Title 10 U.S.C.) for providing nautical charts and marine navigation data for the use of all vessels of the United States and of navigators generally.

The major functions of the Defense Mapping Agency are as follows:

- Advise DoD on MC&G Matters
- Manage all DoD MC&G Resources
- Produce and Distribute Products Worldwide
- Manage all DoD MC&G Research and Development
- Fulfill Statutory Responsibility for Nautical Products

To perform these major functions DMA first must identify with the user. This identification is generally referred to as the "Requirements Process." Within the requirements process there are direct links with the services and U&S Commands to identify their requirements on a yearly cycle to DMA. The requirements are fairly straight forward as long as they apply to standard products and current weapon systems. However, for advanced systems there is no specific procedure. Because weapon system development is fairly dynamic DMA does not have the opportunity to program resources ahead of time to support these systems. A number of considerations are weighed by the Services and DMA prior to supporting advanced systems. These include the substitution of an existing product in lieu of building a new one, the relative priority of each of the weapon systems and the adverse impact on a weapon system development cycle if MC&G data is not available.

Weighing these considerations and other variables such as resources and critical due dates DMA will initiate a program to provide the necessary support. In the case of a major system, when DMA did not have adequate resources, we have gone to DoD and Congress for program enhancements. A good example is the Cruise Missile program. The reason I bring this up is that your systems' impact on DMA should not enter into the decision on whether or

not to identify a requirement. DMA will work with you to sufficiently "scrub down" your requirement so that the essential product is provided. What is achievable under this time constraint of deployment of the system will be limited by technology which DMA can bring to bear on the requirement.

APPLICATIONS

Most people are best familiar with DMA's standard hard copy products - the large, medium, and small scale map and chart. The 1:50,000 topographic map sheet has been the staple for the Army ground forces for years and will continue. The Joint Operation Graphic - Ground, Air and Radar - is used by all the Services to provide map information for joint operations. The various types of hydrographic products are used by both the military and civil community. The list goes on and on for over two hundred products.

What very few people know is that hardcopy production now accounts for less than 50 percent of DMA's support to the services. The softcopy or digital domain has rapidly made inroads in DMA's production processes and products. For example, DMA recently embarked on a modernization program that will result in a total softcopy production process by 1990. We will continue to produce paper products, but from a central mapping, charting and geodetic data base. However, the onus will be on the production of digital data to support a variety of users and weapon systems.

So as not to give one the impression that this digital world is eight years away, it is worthwhile to mention some examples of DMA's digital support to major weapon systems.

Simulators

In the early seventies, recognizing the need to save fuel and aircraft wear and tear, the Air Force and Navy began development of a family of flight simulators using digital cartographic data to produce realistic radar and visual scene simulations. Current operational systems include the B-52/KC-135, C-130, E-2C, A-6E, and the EA-6B. New simulator systems for the F-16, P-3, EF-111B, and the AV-8B will soon be going online.

Weapon Guidance

Digital cartographic data has proven to be the key for precision delivery of guided weapons. The Cruise Missile's ability to reach a target is attained by use of a TERCOM or Terrain Contour Matching data base over which the missile flies to accurately update its position. The Pershing II missile utilizes digital terrain and culture data by correlating stored radar reference scenes with actual radar returns to guide the missile to its target. Without the data provided by the Defense Mapping Agency neither of these weapon systems could meet their designed objectives and accuracies.

C^3I

Sensor simulation and weapons guidance are but two of the many applications of digital cartographic data. Other uses include radar prediction, line-of-sight analysis, mission planning, terrain following/avoidance, and last but not least C^3I. This last use--that of C^3I--is where the true value of digital cartographic data becomes readily apparent.

One may counter this by saying that the traditional map was used by my father and his father before him and is still being used today. The familiar topographic map has served as the standard battlefield information base for several decades. This fact is very true and will continue to be true if future battles are fought in traditional ways and at the pace of a marching soldier. The trouble is that technology is not progressing at the foot soldiers pace, rather it is the vanguard of a comet. One has only to read the latest military or scientific journal to realize that high technology has moved the "Buck Rogers" warfare of science fiction to reality. Space and airborne sensors, relaying battlefield intelligence information in real time to fusion centers, have replaced the forward observer, the reconnaisance mission, and the short wave radio. Sophisticated computers will do in nanoseconds what it would take an intelligence officer hours or days. What we see for the first time is a commander fully cognizant of the entire battlefield, having at his touch tremendous volumes of intelligence data; but possibly, not being able to relate this information to ground coordinates.

"How do I know where the information is coming from?, Where is it in relation to my position and that of the enemy?".

These are the real questions that need answering. In this situation the traditional map is reborn as a display on a cathode ray tube, providng information as it has done for hundred of years--orientation, location, and information. We in the mapping, charting, and geodetic community view this as one of our greatest challenges--the need to create products usable in a dynamic environment such as I have described.

This challenge is manifested in the format and content of products to support C^3I systems. These systems, of which their are many, require a much broader and varied menu of information than that currently provided. Collecting this increased amount of data is part of the problem--rendering it useful to a battlefield commander is a larger problem.

MAPPING, CHARTING, AND GEODETIC IMPLICATIONS

The current evolution in the armed forces towards the electronic battlefield of the future will require MC&G support as in the past, but to an ever increasing degree, this MC&G support will be in digital rather than analog form. As this evolution towards sophisticated digital systems takes place, a potentially alarming pattern is developing. This pattern relates to the fact that the armed forces are so accustomed to receiving maps and charts that they have almost taken for granted the fact that digital cartographic data is also an "off-the-shelf" item. The availability of digital data to support advanced weapons systems must be requested early, since digital data is not generally readily available.

Instituting a sound and detailed MC&G data base strategy when the operational systems to be supported are still in a developmental condition requires judgment, but the pay off in the long run is the fact that once the requirements are firm, they will be in keeping with what DMA can support and what can be ready when the system becomes operational. With regard to this data base strategy three factors comes to mind. They are compatibility, commonality and flexibility.

Compatibility

It is critical that the various C^3I systems being developed in each branch of the armed forces use the same geographic data base, or a derivative of the same data. This is especially true since it can be anticipated that a multiplicity of planning and execution functions will be going on simultaneously in a battlefield situation. Confusion could result from different electronic maps at various command posts. This is not to say that each display must be exactly the same, but rather that features, natural and manmade, should be located at the same geographic coordinates and have available the specific descriptive information needed for a variety of activities.

Commonality

Commonality addresses the fact the DMA will be asked to collect virtually the same information, with slight system dependent variations, more than once. For those of you unfamiliar with the resources required for MC&G production let me remind you that they are not trivial. Producing data the first time is costly. The thought of preparing basically the same information over and over is prohibitive. The problem I am now addressing results from the difference between analog printed maps and charts, and digital records of geographic information. The standard map as it exists today for use by the military represents a collection of a large quantity and variety of information symbolized and annotated. The map reading skills and complex analyses tasks performed by people using maps is only now being realized as one attempts to automate these functions. Another point is that whereas an individual can use one product, a map, for a variety of tasks; machine readable digital cartographic data is system dependent; i.e. the storage and processing capabilities of a weapon system can be an important factor in determining the amount and format of the data which is needed.

Flexibility

A key aspect of working with large amounts of digital data is an appreciation of the amount and detail of the information needed to support various decision making activities. Built into the data base and its subsequent applications software must be the flexibility to give just the information that is required and not inundate the battle commander with too much.

UTILIZATION

Now that one is aware of the MC&G implications, a brief discussion on some positive aspects of what the MC&G data can do is worth noting. The effective use of digital cartographic data can be viewed in two distinct roles. The first, and generally the best understood role, is that of a hard copy map. If one limits himself to only this application of digital cartogrphic data, he is severely degrading the usefulness of the system. The second, and far more important role of digital cartographic data, is in its use in the assessment and analysis of the battlefield. The ability to predict where the enemy can move, and how fast, is an important advantage. The types of assessments of the battlefield that would be available include the following:

- prediction of enemy movement and speed based on detailed information of lines of communication (i.e. roads, railrods)

- prediction of enemy ability for cross-country movement

- employment and management of various sensors by providing obscuration models based on terrain and vegetation

- precision coordinates for targeting

- location of choke points

- assessment of the entire battlefield

A good example of how each of these assessments are being applied is the Air Force's PAVE MOVER program. DMA, working closely with the service and the developer, has developed a test data base, the Tactical Terrain Analysis Data Base, containing the necesary information and detail to enable the intelligence officer to do the analyses. The PAVE MOVER program is a prime example of the benefits realized by early DMA involvement.

CONCLUSION

Based on these remarks, what conclusions can be drawn regarding DMA and C^3I programs. If one limits himself to a single conclusion it would be "WE GOT PROBLEMS". The full potential of digital cartographic data has either not been made known to developers and operators of C^3I systems, or it has been overlooked. One would tend to believe the latter.

To illustrate this point one could consider the Army's new VISTA program or Very Intelligent Surveillance and Target Acquisition. VISTA calls for the integration of stand alone or multi-sensors, dispersed combat information processors, user and commander display systems, and a communications distributed network to provide combat information in near-real time to the brigade and its subordinate elements. The MC&G implications are that the integrated interactive display will allow the operator to operate the system and view imagery or grid referenced target locations in combination with terrain data obtained from stored onboard digital maps. The question is "has anyone thought out the requirements for these digital maps?"

So how do we collectively correct this situation. We at DMA can do our part by frequent interchange of information at conferences and meetings such as this. You the services and developers can help by first informing DMA of your particular system needs, and then by consolidating your requirements so that a minimum number of data bases will support a variety of systems, and not independently develop a unique data base for each. DMA has neither the resources nor the time to support every system as a separate entity. The real answer lies in the fact that the earlier DMA becomes involved in a weapon system development cycle, the better off we will both be. So what's the bottom line in summing up DMA's "silent partner" role. Simply put it is that:

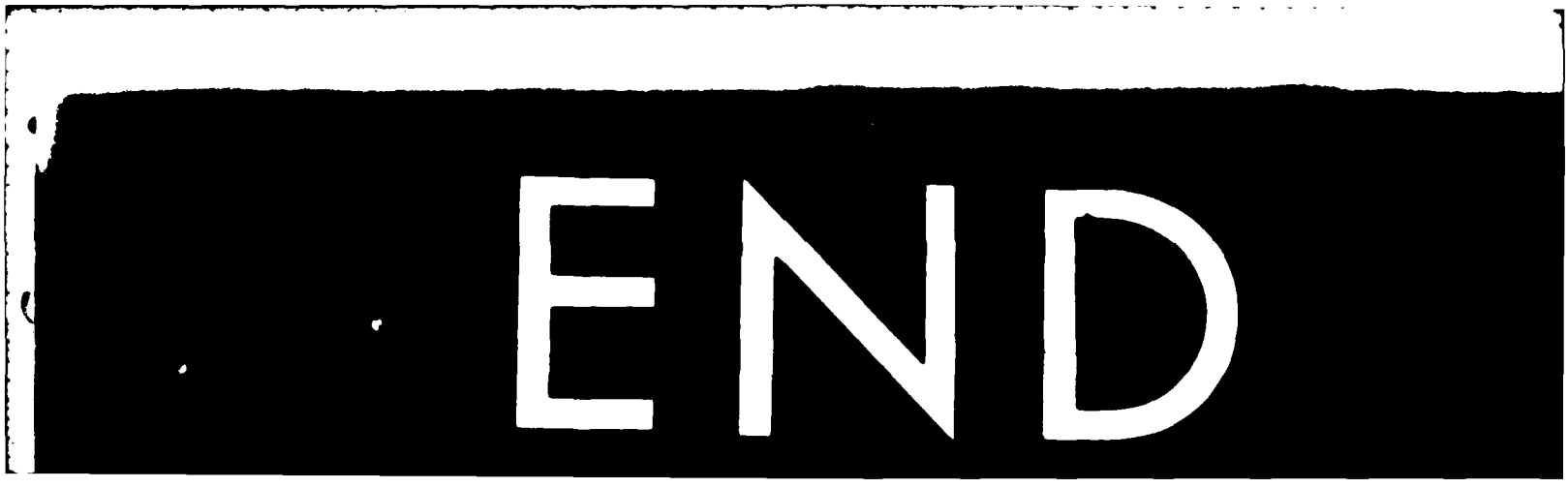
- C^3I Programs have not stated requirements for MC&G support,

- Hard copy and digital products exist to assist system developers,

- DMA early interface with service doctrine, combat, and material developers is critical.

- Develop digital system to directly access DMA data bases, eliminating the costly transformation program.

Without the identification of MC&G requirements early on DMA's ability to fully satisfy future systems, especially fusion systems, will be severely degraded. To coin a phrase from a popular TV commercial, "You can see me now or pay for it later."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